DOCUMENT RESUME

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| AUTHOR | Rushton, Erik; Ryan, Emily; Swift, Charles |
| TITLE | Build an Earthquake City! Grades 6-8. |
| INSTITUTION | Tufts Univ., Medford, MA. |
| PUB DATE | 2001-00-00 |
| NOTE | 8p.; Produced by the Office for Technology and Industry Collaboration. For other activities in series, see SE 068 011-041. |
| AVAILABLE FROM | Web site: www.prek-12engineering.org/activities/ . |
| PUB TYPE | Guides - Classroom - Teacher (052) |
| EDRS PRICE | EDRS Price MF01/PC01 Plus Postage. |
| DESCRIPTORS | Creative Activities; Critical Thinking; *Design; Engineering; *Experiential Learning; Group Activities; Hands on Science; Middle Schools; Science Education; Science Instruction; Science Process Skills; *Seismology; Student Motivation |

ABSTRACT

In this activity, students build a city out of sugar cubes, bouillon cubes, and gelatin cubes. The city is then put through simulated earthquakes to see which cube structures withstand the shaking the best. This activity requires a 50-minute time period for completion. (Author/SOE)

Activity: **Build an Earthquake City!!!**

## GRADE LEVELS: 6-8

## SUMMARY:

Students will build a city out of sugar cubes, bouillon cubes, and gelatin cubes. The city will be put through simulated earthquakes to see which cube structures withstand the shaking the best.

LEVEL OF DIFFICULTY [1 = Least Difficult: 5 = Most Difficult]

1-least difficult

TIME REQUIRED

20 minutes for construction

30 minutes for testing

COST

$5.00

## STANDARDS:

2.5 Explain how such design features as size, shape, weight, function and cost limitations (i.e., ergonomics) would affect the construction of a given prototype.

1.1 Given a design task, identify appropriate materials (e.g., wood, paper, plastic, aggregates, ceramics, metals, solvents, adhesives) based on specific properties and characteristics (i.e., weight, strength, hardness and flexibility).

## WHAT WILL THE STUDENTS LEARN?

The effect of earthquakes on structures.

The importance of strong buildings to prevent destruction by earthquakes.

How the epicenter of an earthquake affects buildings.

Different materials may be used in the construction of buildings.

## BACKGROUND INFORMATION:

When there is an earthquake, energy travels through the earth and can cause damage to buildings and other structures far away. The amount of damage caused by an earthquake depends on several things such as the strength of the earthquake, how long it lasts, and where it happens.

The epicenter of an earthquake is the point on the earth's surface directly above where an earthquake starts, or where the shaking begins. The damage will typically be the greatest at the epicenter.

Today, some skyscrapers are made of more flexible materials so that they bend and sway during an earthquake and do not fall down as easily.

## RESOURCES:

http://earthquake.usgs.gov/4kids excellent resource for more background information on earthquakes.

Books: **Earthquakes** by Seymour Simon; Mulberry Books, April 1995

## MATERIALS:

Box with smooth bottom, at least 25-cm wide X 20-cm long

Sugar cubes

Bouillon cubes

Gelatin cubes (Follow instructions on box to make, but use 1/3 as much water as the recipe calls for. Use a pan or ice cube tray. Chill until very firm and cut into small cubes, about the size of sugar and bouillon cubes).

Pencil

Ruler

(Optional: wood and plastic cubes as additional building materials)

## PREPARATION:

Buy or assemble materials

Prepare gelatin cubes

Discuss with the class what an earthquake is and what the epicenter of an earthquake is.

## DIRECTIONS:

1. Split the students into small groups or pairs and give each group a box bottom.
2. Using the pencil and ruler, have the students create a grid on the box by drawing 4 vertical lines and 5 horizontal lines; each line should be 5-cm apart. Label the vertical lines 1st Avenue, 2nd Avenue, 3rd Avenue, etc., and the horizontal lines A Street, B Street, C Street, etc. This is the earthquake city.
3. To show that earthquakes can cause damage to buildings, have the students build three sugar cube skyscrapers, each one five sugar cubes tall. Build the skyscrapers at the following corners: A and 1st , B and 2nd , C and 3rd .
4. Now have the students simulate an earthquake by tapping on the corner of D and 4th with the eraser of a pencil. They should continue to tap until at least one cube from each skyscraper falls. Ask: Which skyscraper falls first? In a real earthquake, do you think more damage would happen in one place than another? Where would the most damage happen?
5. The students should try step 4 again, but use different strength taps, representing hard vibrations and soft vibrations. They should determine how many hard or soft vibrations it takes to knock over buildings different distances away from the epicenter.
6. Have students record results in a chart containing the location of the skyscraper and when it fell.
7. Now allow the students to experiment with different types of cubes. Encourage them to create skyscrapers from a variety of blocks and of different heights.
8. After they have had time to experiment with the different types of blocks, each group should build a city of skyscrapers. The cities may be as large as they wish but must have at least five skyscrapers of different heights.
9. Once they have completed their cities, go around to each group and tap with your pencil at a corner in the city to test how earthquake resistant they are.
10. After the cities have been tested, students should put away materials and you can have a discussion about what the students discovered.

## INVESTIGATING QUESTIONS:

Why is it useful to build skyscrapers out of different materials?

Which materials were the best to use for taller buildings?

Which cubes were the most earthquake resistant? Why?

Which skyscrapers fell first in the earthquakes? Where were they located in respect to the epicenter of the earthquake?

What happens when the top of a skyscraper is heavier than the bottom, or when the bottom is heavier than the top?

## REFERENCES:

Kessler, James H. and Andrea Bennett. The Best of Wonderscience: elementary science activities. Boston: Delmar Publishers, 1997. ISBN: 0827380941 p. 322-324.*

*Adapted with permission from The Best of Wonderscience, Copyright 1997, American Chemical Society Published by Wadsworth Publishing, Inc.. If you enjoyed this activity check out www.chemistry.org/wondernet, Your Science Place in Cyberspace, for free elementary physical science activities.

| Rubric for Performance Assessment | | | | | | |
|---|---|---|---|---|---|---|
| Activity Title: | Build an Earthquake Resistant City | | | Grade Level:6-8 | | |
| | | | | | | |
| | 1 | 2 | 3 | 4 | | |
| Criteria | Beginning | Developing | Proficient | Advanced | (X factor) | Subtotal |
| PERFORMANCE | Testing was unorganized and students were not focused to the task. | Students followed some of the directions for testing, but not all. | Students followed all directions. | Students followed all directions went beyond the expectations. | | |
| TEAMWORK | Only one of the team members did the design and testing. | Most of the team members worked together on the design and testing. | All members of the team participated in design and testing. | All members of the team participated in design and testing and worked well together. | | |
| UNDERSTANDING | Students did not understand the goal of this activity and could not simulate an earthquake. | With guidance, students began to understand how to simulate buildings in an earthquake. | Students understood goal of activity and were able to simulate buildings in an earthquake. | Students understood goal of activity and went beyond expectations for building an earthquake resistant city. | | |
| | | | | | Total: | |
| Teacher Comments: | | | | | | |

Name_____

Earthquake City Testing

| Location of Building | Location of Earthquake Epicenter | Hard or Soft Vibrations? | After how many taps did the building fall? |
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What type of building was the hardest to knock down by the earthquake?

PreK-12 ENGINEERING

Activity Evaluation Form www.k12engineering.org

**Activity Name:** _____

**Grade Level the Activity was implemented at:** _____

**Was this Activity effective at this grade level (if so, why, and if not, why not)?**

What were the Activity's strong points?

What were its weak points?

**Was the suggested Time Required sufficient** (if not, which aspects of the Activity took shorter or longer than expected)?

**Was the supposed Cost accurate** (if not, what were some factors that contributed to either lower or higher costs)?

**Do you think that the Activity sufficiently represented the listed MA Framework Standards** (if not, do you have suggestions that might improve the Activity's relevance)?

**Was the suggested Preparation sufficient in raising the students' initial familiarity with the Activity's topic** (if not, do you have suggestions of steps that might be added here)?

**If there were any attached Rubrics or Worksheets, were they effective** (if not, do you have suggestions for their improvement)?

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I. DOCUMENT IDENTIFICATION:

Title: PreK-12 Engineering Activities

1) Touch and Discover, Grades PreK-2
http://www.prek-12engineering.org/data/d2/Touchdiscover.pdf

2) Invent a Backscratcher from Everyday Materials, Grades PreK-2
http://www.prek-12engineering.org/data/d28/Backscratcher.pdf

3) Compare Human-Made Objects with Natural Objects, Grades PreK-5
http://www.prek-12engineering.org/data/d34/HumanvsNatural.pdf

4) Do Different Colors Absorb Heat Better?, Grades PreK-2
http://www.prek-12engineering.org/data/d37/Absorbheat.pdf

5) Which Roof is Tops?, Grades PreK-2
http://www.prek-12engineering.org/data/d44/RoofTops.pdf

6) Make Your Own Recycled Paper, Grades PreK-2
http://www.prek-12engineering.org/data/d56/Recycle.pdf

7) Build an Approximate Scale Model of an Object Using LEGOs, Grades 3-5
http://www.prek-12engineering.org/data/d3/LegoScaleModel.pdf

8) Design Weather Instruments using Lego Sensors, Grades 3-5
http://www.prek-12engineering.org/data/d4/LegoWeather.pdf

9) Space Shelter, Grades 3-5
http://www.prek-12engineering.org/data/d5/SpaceShelter.pdf

10) Build a Bird House, Grades 3-5
http://www.prek-12engineering.org/data/d6/BirdHouse.pdf

11) Ball Bounce Experiment, Grades 3-5
http://www.prek-12engineering.org/data/d6/BallBounce.pdf

12) Make an Alarm!, Grades 3-5
http://www.prek-12engineering.org/data/d11/MakeAlarm.pdf

13) Design Packing to Safely Mail Raw Spaghetti, Grades 3-5
http://www.prek-12engineering.org/data/d17/MailSpaghetti.pdf

14) Disassemble a Click Pen, Grades 3-5
http://www.prek-12engineering.org/data/d33/clickPen.pdf

15) Construct And Test Roofs for Different Climates, Grades 3-5
http://www.prek-12engineering.org/data/d35/ClimateRoof.pdf

16) Compare Fabric Materials, Grades 3-5
http://www.prek-12engineering.org/data/d36/Fabric.pdf

17) A House is a House for Me, Grades 3-5
http://www.prek-12engineering.org/data/d52/House.pdf

18) Water Filtration, Grades 3-5
http://www.prek-12engineering.org/data/d53/Water Filtration.pdf

19) What is the Best Insulator: Air, Styrofoam, Foil, or Cotton?, Grades 3-5
http://www.prek-12engineering.org/data/d54/BestInsulator.pdf

20) Design a Recycling Game!, Grades 3-5
http://www.prek-12engineering.org/data/d55/Recycling.pdf

21) Tower Investigation and the Egg, Grades 6-8
http://www.prek-12engineering.org/data/d7/TowerEgg.pdf

22) Wimpy Radar Antenna!, Grades 6-8
http://www.prek-12engineering.org/data/d10/WimpyAntenna.pdf

23) Portable Sundial, Grades 6-8
http://www.prek-12engineering.org/data/d30/PortableSundial.pdf

24) An Introduction To Loads Acting on Structures, Grades 6-8
http://www.prek-12engineering.org/data/d31/IntroLoads.pdf

25) Design Your Own Rube Goldberg Machine, Grades 6-8
http://www.prek-12engineering.org/data/d32/RubeGoldberg.pdf

26) Building Totrahedral Kites, Grades 6-8
http://www.prek-12engineering.org/data/d38/tetrakites.pdf

27) Do as the Romans: Construct an Aqueduct!, Grades 6-8
http://www.prek-12engineering.org/data/d39/Aqueduct.pdf

28) Build an Earthquake City!!, Grades 6-8
http://www.prek-12engineering.org/data/d40/EarthquakeCity.pdf

29) Design a Parachute, Grades 6-8
http://www.prek-12engineering.org/data/d41/Parachute.pdf

30) The Squeeze is On, Grades 6-8
http://www.prek-12engineering.org/data/d42/Squeeze.pdf

31) Stop The Stretching, Grades 6-8
http://www.prek-12engineering.org/data/d43/StopStretching.pdf

32) Speaker Project, Grades 9-10
http://www.prek-12engineering.org/data/d13/Speaker.pdf

Author(s): Erik Rushton, Emily Ryan, Charles Swift

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Signature: Margaret Newell

Printed Name/Position/Title: Margaret Newell, Associate Provost for Research

Organization/Address: Tufts University
136 Harrison Avenue, Suite 75K-401
Boston, MA 02111

Telephone: 617-636-6550
Fax: 617-636-2917
E-mail Address: peter.wong@tufts.edu

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